RESEARCH DEPARTMENT

LONG DISTANCE OVERLAND TROPOSPHERIC PROPAGATION MEASUREMENTS ON 774 Mc/s

Report No. K-155

(1962/36)

THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

RESEARCH DEPARTMENT

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SUMMARY

This report presents the results of field strength measurements on u.h.f. transmissions on 774 Mc/s over land paths at distances from 53 miles (85 km) to 294 miles (473 km). These measurements extended over a period of approximately two years and have been used in the preparation of field strength/distance curves for various percentage times.

The field strength/distance curves derived in this report are compared with similar curves derived from measurements made on Band IV transmissions over land paths and reveal significant differences only for very low percentage times. Field strength/distance curves have been derived for the Bands IV and V combined results.

The measurements have been used by Study Group V of the C.C.I.R. in the preparation of field strength curves for tropospheric propagation at distances beyond the horizon.

1. INTRODUCTION

Information is required on the magnitude and duration of occurrence of signals propagated over long distances in order to operate common channel u.h.f. transmitters with the minimum amount of mutual interference.

Long distance propagation tests have been made by the B.B.C. Research Department on transmissions in Band IV[1] as part of the B.B.C.'s contribution to the C.C.I.R. Study Programme on tropospheric wave propagation at distances well beyond the horizon. A series of measurements was then made on transmissions in Band V to supplement the data already available concerning tropospheric propagation at u.h.f.

This report covers the results of measurements made on 774 Mc/s during the period from January 1959 to November 1960. The results presented in this report have been used by Study Group V of the C.C.I.R. and have been incorporated in the field strength/distance curves for tropospheric propagation in the u.h.f. bands issued by the Meeting of Experts, Cannes 1961, in Document 64.

2. TRANSMISSION PATHS

The transmitter was sited at the B.B.C.'s television and v.h.f. station at Pontop Pike in County Durham. Receivers were installed at Dorket Head near

Nottingham, Mursley in Buckinghamshire, Kingswood in Surrey, and Beddingham in Sussex, providing transmission paths of from 133 miles (214 km) to 294 miles (473 km). Measurements had been made over these paths on transmissions in Band IV.[1] Receivers were installed also at Dishforth and Moorside Edge, both in Yorkshire, to provide transmission paths of 53 miles (85 km) and 87 miles (140 km) respectively.

Measurements at Dishforth began in June 1959. Measurements at the other sites commenced in January 1959.

Fig. 1 shows the geographical distribution of the sites.

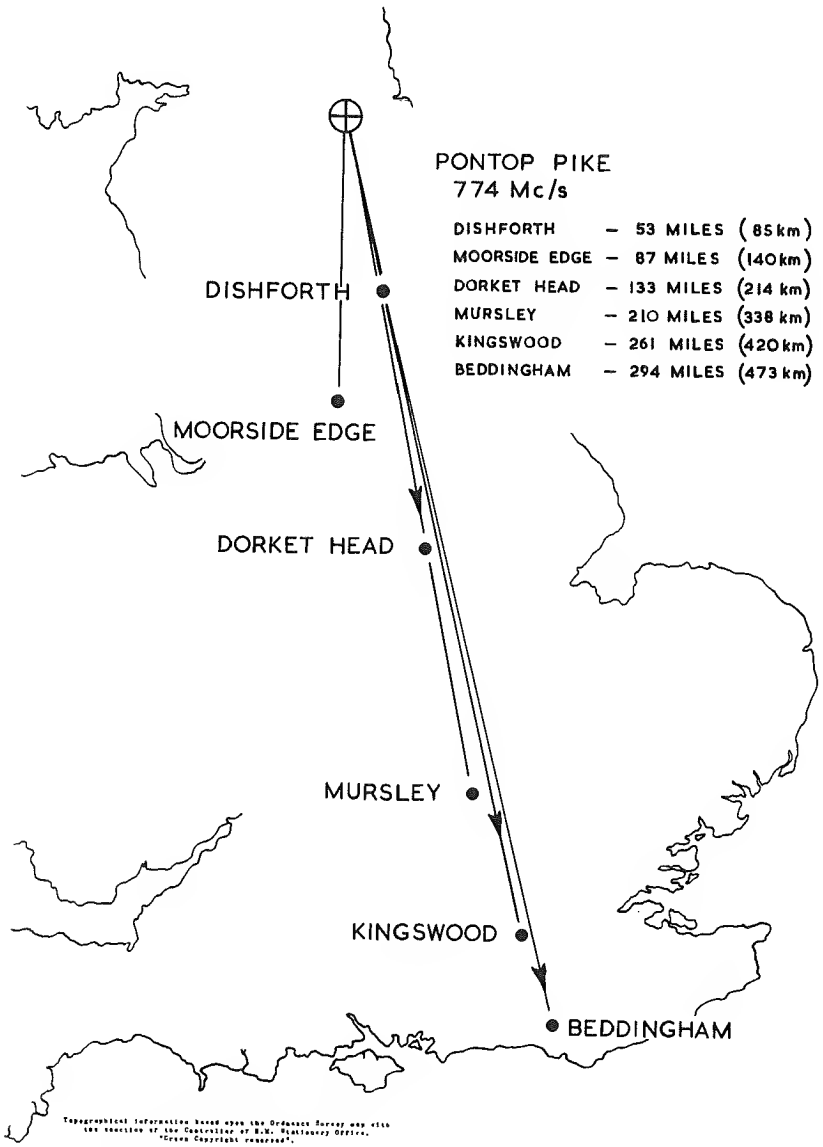

Fig. 1 - Geographical distribution of transmitting and receiving sites

⊕ Transmitting site
● Receiving site

3. EQUIPMENT AND SITES

3.1. Transmitting Site Details

The transmitter operated on a carrier frequency of 774 Mc/s. Transmissions were 100% "square wave" modulated at 1,000 c/s and were cut automatically for two seconds every minute so that signal could be identified at the receiving sites. Transmitting site details are given in Table 1.

TABLE 1

Transmitting Site	Site Height a.m.s.l.		Aerial Height a.g.l.		Latitude	Longitude	Max. E.R.P.	Direction of Max. Radiation	Polarization
	ft	m	ft	m					
Pontop Pike	1000	305	400	122	54°52'08"N	01°46'11"W	780W	164°T	H

The horizontal radiation pattern (h.r.p.) of the transmitting aerial, a corner reflector, was 3 dB below maximum at ± 24° off the bearing of maximum radiation.

3.2. Receiving Site Details

The type of receiver used during these measurements has been described in detail in an earlier Research Department report.[2] The main features of the receiver are its high sensitivity and gain stability. A high output signal-to-noise ratio is achieved by using 1,000 c/s modulation at the transmitter and restricting the bandwidth of the receiver circuits following the detector.

Transmission loss, transmitted power and sensitivity of the receivers were such that at Kingswood and Beddingham signal was received above noise level for only 0·17% and 0·9% of the total time. Auto-correlation detectors[3] were added after the 1,000 c/s amplifier stages to increase the sensitivity of the receivers, but it was found that the gain stability of the receivers was impaired. The auto-correlation detectors were kept in circuit for some months and the lower field strengths thus obtained have been taken as a guide for extrapolating the field strength/percentage time curves.

The receiving aerials were double nine-element Yagis with a gain of 12 dB relative to a dipole. Receiving site details are given in Table 2.

TABLE 2

Receiving Site	Path Distance		Site Height a.m.s.l.		Aerial Height a.g.l.		Bearing from Transmitter	Latitude	Longitude
	miles	km	ft	m	ft	m	°T		
Dishforth	53	85	112	34	40	12	164°	54°08'43"N	01°25'25"W
Moorside Edge	87	140	1110	339	40	12	184°	53°38'01"N	01°53'35"W
Dorket Head	133	214	460	140	30	9	169°	53°01'02"N	01°06'48"W
Mursley	210	338	520	158	30	9	169°	51°57'12"N	00°48'05"W
Kingswood	261	420	550	167	30	9	165°	51°17'15"N	00°12'50"W
Beddingham	294	473	600	183	30	9	164°	50°50'02"N	00°04'15"E

4. RESULTS

4.1. Analysis

The transmitter radiated from 0900–2300 hours daily. Recording charts were run at speeds of 3 in (7·6 cm) or 6 in (15·2 cm) per hour depending on the type of fading normally received at the site. Analysis consisted of determining the time during which the signal exceeded each of several fixed recording chart levels, the receiving chart levels corresponding to certain levels of field strength. Each daily recording was analysed in two periods, 0900–1800 hours and 1800–2300 hours. These periods were grouped together monthly and expressed as signal level exceeded for given percentages of the valid recording time. The months were combined to give the overall results.

4.2. Variations of Field Strength with Time at the Receiving Sites

The analysis of the measurements made is shown in Fig. 2 plotted as field strength against percentage valid recording time. Tabulated results are given in Table 3 for certain fixed percentage times.

TABLE 3

Curve	Site	Distance from Transmitter	Measured Field Strength (dB rel. 1 μV/m for 1 kW e.r.p.)			
		km	0·1%	1%	10%	50%
a	Dishforth	85	62·5	56·5	50·0	46·5
b	Moorside Edge	140	38·5	27·0	15·0	4·5*
c	Dorket Head	214	32·0	18·0	4·0*	NL
d	Mursley	338	35·0	15·5	2·0*	NL
e	Kingswood	420	10·0	−5·0*	−17·0⊥	NL
f	Beddingham	473	29·5	7·0	−10·0⊥	NL

NL = noise level
*Extrapolated result
⊥Assumed values

It is of interest to note in Fig. 2 that the field strength received for low percentage times at Mursley (less than 0·35% time) is in excess of the field strength received at Dorket Head and at very low percentage times (less than 0·05% time) is even in excess of the Moorside Edge field strength. The cause of this phenomenon has not been determined, although it is considered that the effect is enhanced by the favourable transmission path to Mursley. The measurements made on Band IV[1] over transmission paths from Pontop Pike to Dorket Head and Mursley showed a similar phenomenon for the low percentage times.

It is seen that during the low percentage time that signal was above noise level, the field strength received at Beddingham is in excess of that received at Kingswood by 15–20 dB. This is considered to be due to differences in transmission paths.

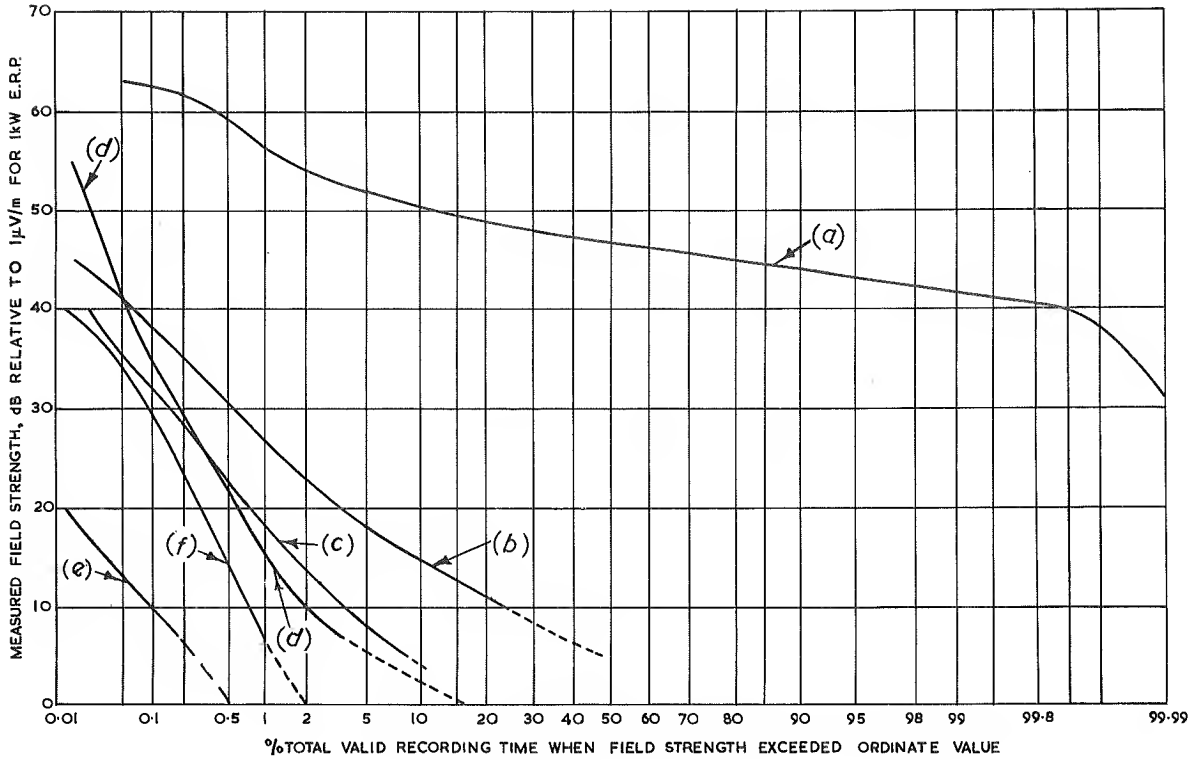

Fig. 2 - Pontop Pike (774 Mc/s) - Variation of field strength with time

Curve	Receiver	Distance		Total Hours Recorded	Free* Space Field
		mi	km		
(a)	Dishforth	53	85	6695	68·4
(b)	Moorside Edge	87	140	8815	64·0
(c)	Dorket Head	133	214	8390	60·3
(d)	Mursley	210	338	8497	56·3
(e)	Kingswood	261	420	8728	54·4
(f)	Beddingham	294	473	8800	53·4

* dB rel. 1 μV/m for 1 kW e.r.p.

The curves shown dotted in Fig. 2 (d), (e) and (f) are of field strength plotted against the percentage of the valid recording time when auto-correlation detectors were in circuit, and are of some assistance in extrapolating to obtain 10% values of field strength.

Extrapolating from the very low percentage times that signal at Kingswood and Beddingham exceeded noise level to produce the field strengths exceeded for 10% of the time must lead to very approximate field strengths. Field strengths for 10% time have been extracted since they may be of use in deciding the slope of the 10% time field strength/distance curve at the greater distances.

4.3. Monthly Field Strength Variations

The field strengths exceeded in each month for certain selected percentage

times are plotted in Fig. 3 for each transmission path. The levels of field strength exceeded monthly for the low percentage times may be influenced by failure of equipment during part of a month, but it is of interest that higher monthly field strengths were more sustained during 1959 than in 1960, especially at the greater distances. Abnormally high signals were received during January and February of 1959 and also during much of the excellent summer of that year. Indeed, the 0·1% value in January 1959 for Mursley exceeds the free space field for that distance (56·4 dB rel. 1 μV/m).

4.4. Receiving Site Correction Factors

The receiving sites chosen are often not representative of average reception conditions in the areas surrounding them. In earlier experiments on Bands III[4] and IV[1] correction factors, known as site variation factors, were applied to the measured results to obtain field strengths representative of the areas round the sites.

A measurement of the site variation factor was obtained by choosing 15 to 20 sites within a 5-mile (8 km) radius of the receiving site and comparing the field strength at each of these sites with the field strength at the fixed site. The average of the ratio in decibels of the field strengths at the mobile sites and the appropriate fixed site field strength was taken as the site variation factor.

The site variation factor, thus defined, is determined by the local topography and to a lesser extent by changes in transmission path. The average field strength in the area surrounding a site may not be representative of the average field strength received over many transmission paths of the same length. A receiving site may be situated on a plain, as at Dishforth, and the area around the site may receive field strengths in excess of those generally received over that path length.

Approximate correction factors were found for Dishforth and Moorside Edge which may be applied to the measured results to give field strengths relating to average transmission paths of appropriate lengths. The field strength at spot points along arcs centred on the transmitting site and passing through the fixed receiving sites was compared with the field strength measured at the fixed sites. The results are given below.

4.4.1. Dishforth Correction Factor

Measurements were made at spot points with the receiving aerial at 30 ft (9·1 m) above ground level (a.g.l.) at approximately 2° intervals along a 30-mile (48 km) arc of radius 53 miles (85 km) centred on Pontop Pike. The spot points were chosen to be clear of local obstacles but were otherwise as near as practicable to the degree points. Recordings were made for about ten minutes only at each point since tropospheric conditions were such that there was little fading. The measurements gave a correction factor of -10 dB. Details of the spot points are given in Appendix I.

4.4.2. Moorside Edge Correction Factor

The signal received at Moorside Edge in the absence of abnormal tropospheric conditions was of a rapidly fading nature and near the limit of receiver sensitivity. It was impracticable to wait for periods of abnormal propagation, especially since the eastern extremity of the arc over which it was hoped to make spot point measurements was some 50 miles (80 km) from the fixed site and comparisons of lengthy duration would be necessary.

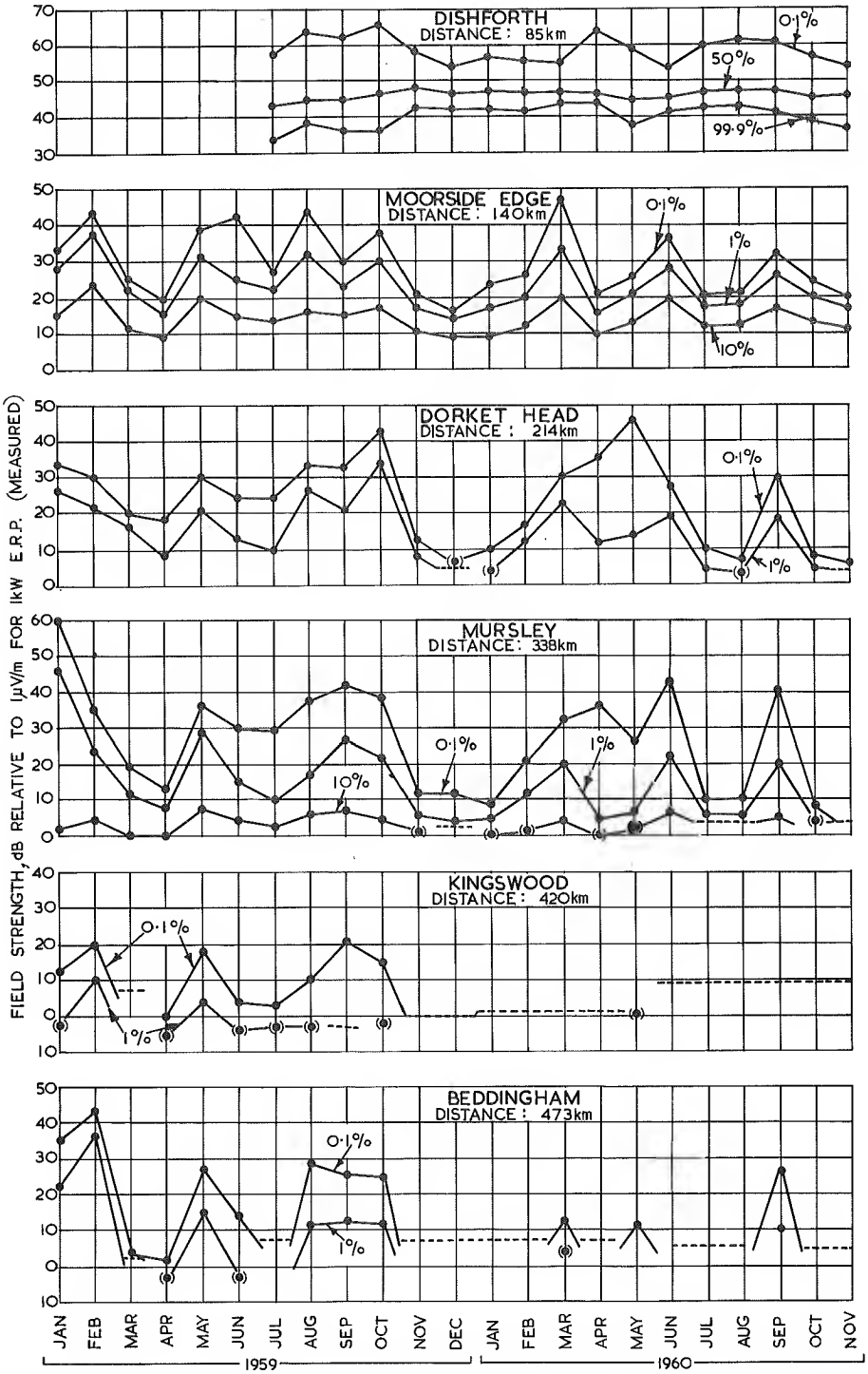

Fig. 3 - Pontop Pike (774 Mc/s) - Field strength exceeded in each month for selected % times

(◉) Extrapolated values

– – – – Noise level

A receiver was installed at Barnsdale Bar, near Pontefract, Yorkshire, approximately in the centre of the arc of radius 87 miles (140 km) along which measurements were made. At this site signal was normally above noise level. Measurements were made at spot points at approximately 4° intervals along the arc with a receiving aerial at 30 ft (9·1 m) a.g.l. Recordings of field strength were made over durations of from one to three hours. Median values of field strength recorded at the spot points within 11 miles (18 km) of Moorside Edge were compared with the appropriate field strengths at Moorside Edge. The remaining median field strengths were compared with the Barnsdale Bar field strengths. It was possible to make several of the latter comparisons during normal propagation conditions.

At the end of the measurements 58 hours of simultaneous recording at Barnsdale Bar and Moorside Edge, measured over a period of one month, were available to give an adjustment to apply to those points which had been compared with Barnsdale Bar. The median field strength at Barnsdale Bar was 16 dB above that at Moorside Edge over this period.

Details of the spot points are given in Appendix II. These measurements gave a correction factor of -1 dB for Moorside Edge (or -17 dB for Barnsdale Bar).

4.4.3. Assumed Correction Factors for the Remaining Sites

It was not practicable to attempt to obtain correction factors for the more distant sites, since signal was present only during abnormal conditions. In order to produce more representative field strength/distance curves, it was considered that some adjustment should be given to the measured field strengths at the distant sites and the site variation factors measured during earlier experiments in lower frequencies have been used. All correction factors are listed in Table 4.

TABLE 4

Receiving Site	Correction Factors		Correction in dB
	Transmitting Site	Frequency Band	
Dishforth	Pontop Pike	V	-10·0
Moorside Edge	Pontop Pike	V	-1·0
Dorket Head	Pontop Pike	III	-1·5
Mursley	Sutton Coldfield) Holme Moss)	III	-10·0*
Kingswood	Sutton Coldfield	III	+5·5
Beddingham	Sutton Coldfield	III	-13·5

*Average of Sutton Coldfield and Holme Moss measurements

4.5. Band V Field Strength/Distance Curves

The field strengths, measured and extrapolated, derived from this experiment and adjusted by their appropriate factors are listed in Table 5 for certain percentage times.

TABLE 5

Receiving Site	Distance from Transmitter km	"Corrected" Field Strength in dB rel. 1 μV/m for 1 kW e.r.p.		
		0·1%	1·0%	10%
Dishforth	85	52·5	46·5	40·0
Moorside Edge	140	37·5	26·0	14·0
Dorket Head	214	30·5	16·5	2·5
Mursley	338	25·0	5·5	-8·0
Kingswood	420	15·5	0·5	-11·5
Beddingham	473	16·0	-6·5	-23·5

These field strengths have been plotted in Fig. 4 against distance.

Lines of "best fit", calculated by the method of least squares for a logarithmic distance scale, are drawn through the points relating to each percentage time. Two 10% time curves are shown, one derived from all the corrected field strengths given in Table 5, the other being derived from the 10% time values of only the four nearest sites, that is, leaving out the extrapolated field strengths of Kingswood and Beddingham. The difference between these curves is no greater than 2½ dB at 500 km.

An inverse power relationship is implied between field strength, E, and distance, d, of the form $E = k/d^m$ where k is a parameter related to the transmission path and to the transmitter power. Values of m and 20 log k are shown in Table 6.

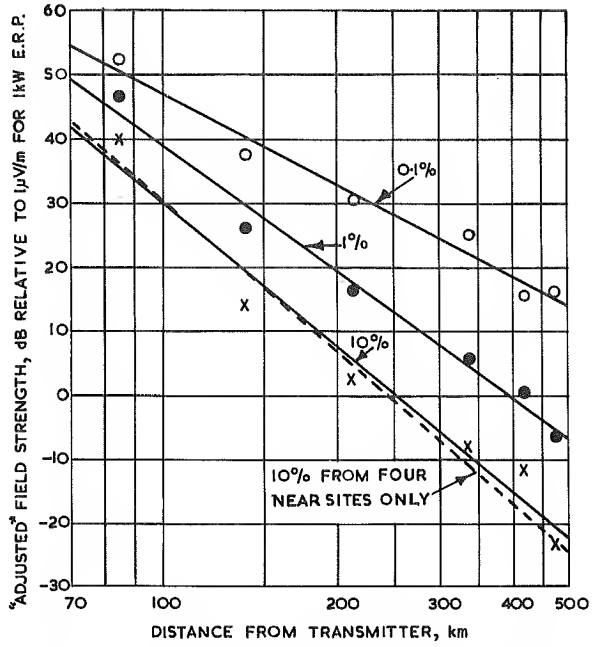

Fig. 4 - Band V - Variation of corrected field strength with distance

O 0·1% time
● 1% time
X 10% time

TABLE 6

Band V - Slope of Field Strength/Distance Curves

Percentage Time	m	20 log k
0·1%	-2·38	142·2
1%	-3·29	170·6
10%*	-3·76	180·9

* Including extrapolation

5. BAND V RESULTS COMPARED WITH THE RESULTS OF EARLIER MEASUREMENTS

5.1. Comparisons over the Same Paths

The four distant receiving sites at which measurements were made during this experiment had been used for earlier measurements on transmissions from Pontop Pike on Band IV. The field strengths derived from the different experiments are tabulated for certain percentage times in Table 7.

TABLE 7

Comparison of Field Strengths Received from Pontop Pike in Bands IV and V

Receiving Site	Period of Experiment	Frequency	Measured Field Strength (dB rel. 1 μV/m for 1 kW e.r.p.)		
			0·1%	1%	10%
Dorket Head (214 km)	Jan. 1957 – June 1958	560 Mc/s	25·5	12·5	0·5
	Jan. 1959 – Nov. 1960	774 Mc/s	32·0	18·0	4·0
Mursley (338 km)	Jan. 1957 – June 1958	560 Mc/s	47·5	21·5	4·0
	Jan. 1959 – Nov. 1960	774 Mc/s	35·0	15·5	2·0
Kingswood (420 km)	Jan. 1957 – Dec. 1957	560 Mc/s	28·0	0·5	
	Jan. 1959 – Nov. 1960	774 Mc/s	10·0	−5·0*	
Beddingham (473 km)	Jan. 1957 – June 1958	560 Mc/s	35·0	5·5	
	Jan. 1959 – Nov. 1960	774 Mc/s	29·5	7·0*	

*Extrapolated field strengths

It is seen in Table 7 that, except at Dorket Head, higher field strengths were measured on the 560 Mc/s transmissions, especially for the lower percentage times.

5.2. Comparison of Overland Field Strength/Distance Curves

The corrected Band V field strength/distance curves given in Fig. 4, together with the field strength/distance curves derived from the Band IV measurements for 0·1%, 1% and 10% time respectively, are plotted in Fig. 5.

It will be seen that for 0·1% time the Band IV curve shows field strengths greater than the Band V curve by some 6 dB. The difference between the 1% time curves is no greater than 4 dB at 100 km and decreases with increasing distance.

The Band IV and V 10% time curves in Fig. 5 are based to some extent on extrapolated values of field strength. The curves obtained by leaving out the extrapolated field strengths are drawn in Fig. 6. The differences in propagation between the Band IV and Band V curves for 10% time based on measured results are no greater than 3 dB at 100 km and decrease with increasing distance.

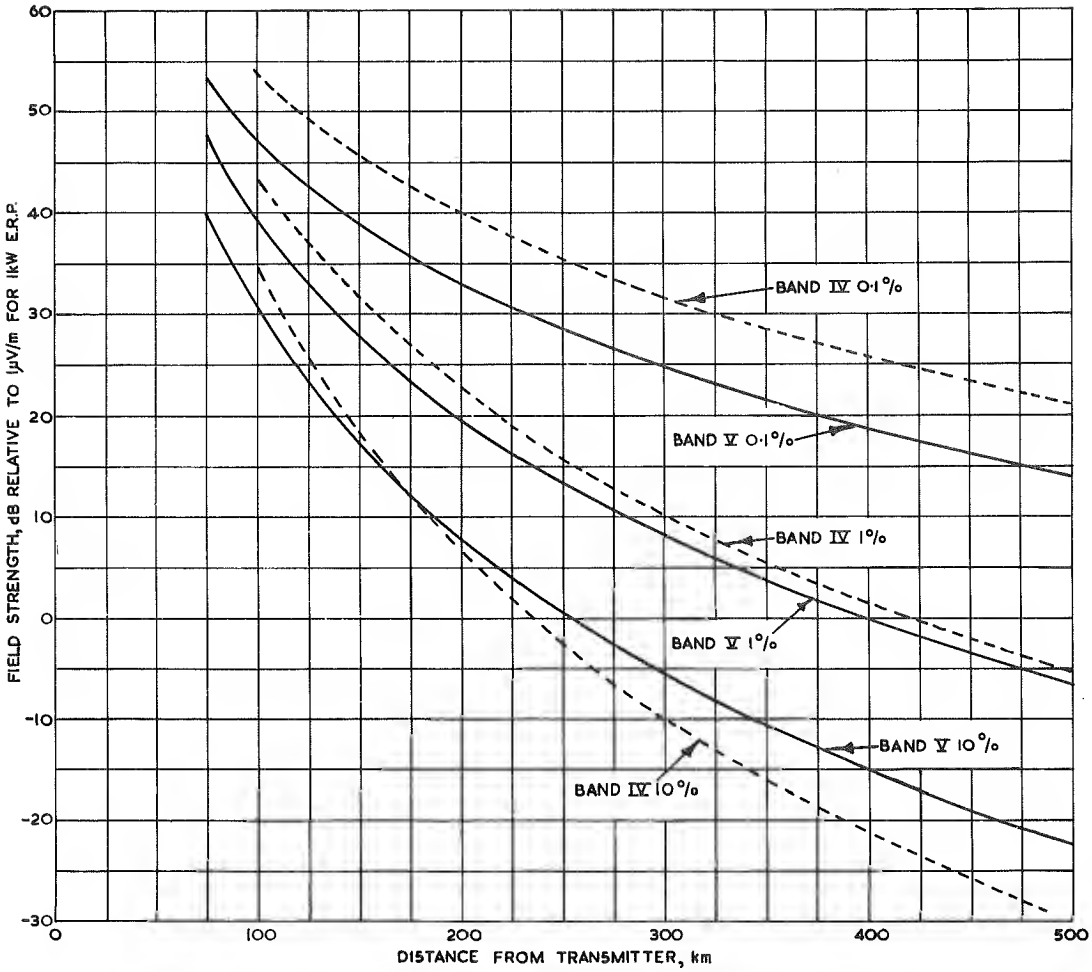

Fig. 5 - Bands IV and V - Variations of corrected field strength with distance

It is considered that the differences between the Band IV and Band V field strength/distance curves for 1% and 10% time are not significant; transmission paths, methods of assessing correction factors and the periods over which measurements were made vary between the experiments. The 1% and 10% field strength/distance curves for transmissions in Bands IV and V may be combined for 1% and 10% time.

6. U.H.F. FIELD STRENGTH/DISTANCE CURVES DERIVED FROM B.B.C. MEASUREMENTS

6.1. Field Strength/Distance Curve for Bands IV and V Combined

The field strengths corrected by their appropriate factors and derived from the Band IV and V overland experiments have been plotted in Figs. 7 and 8 against distance for 1% and 10% time respectively. Lines of best fit, calculated by the least squares method on a logarithmic distance basis, have been drawn through the points. The 10% time curve including extrapolations has been shown dotted and it will be seen that it differs very little from the 10% time curve without extrapolations.

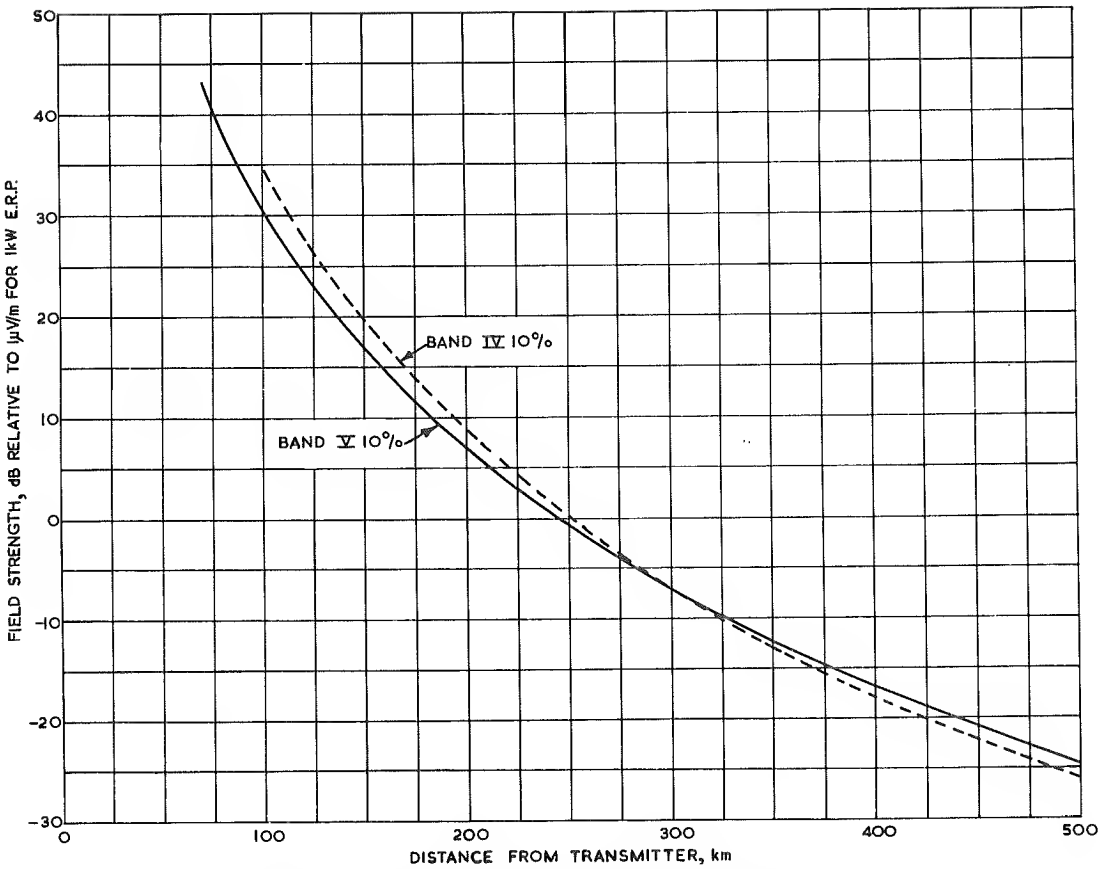

Fig. 6 - Bands IV and V - Variations of corrected 10% time field strength with distance (without extrapolated results)

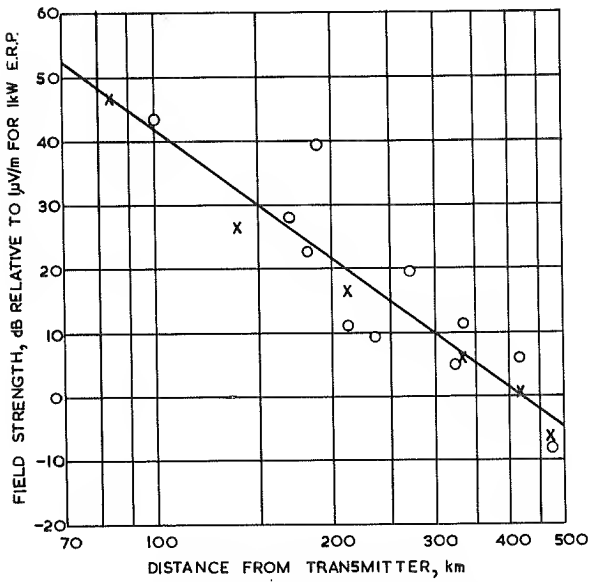

Fig. 7 - Bands IV and V combined, 1% time - field strength/distance curves

O Band IV result
X Band V result

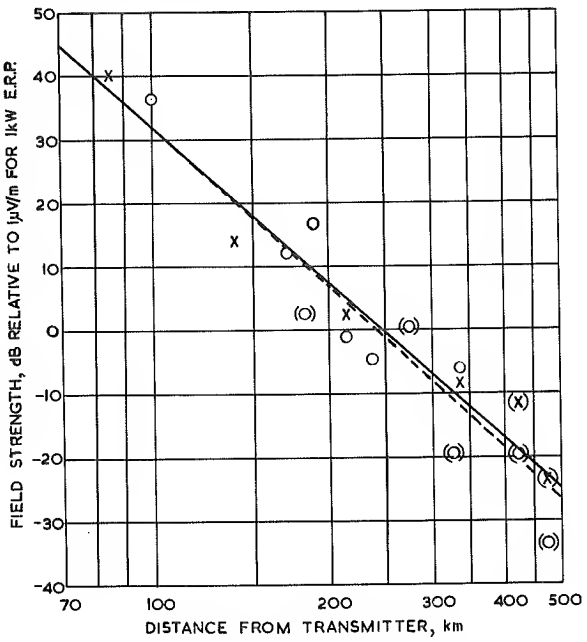

Fig. 8 - Bands IV and V combined, 10% time - field strength/distance curves

O Band IV result ( ) Extrapolated result
X Band V result

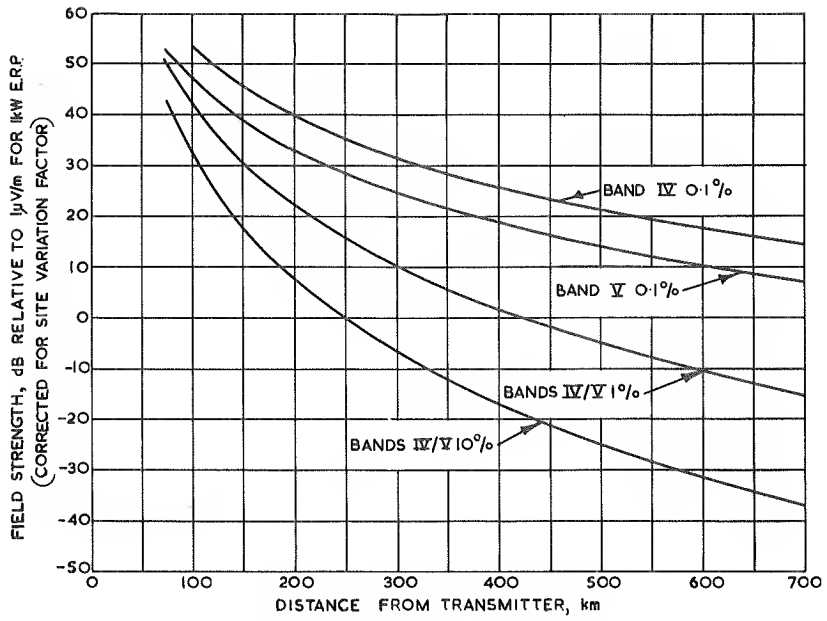

Fig. 9 - Field strength/distance curves, Bands IV and V combined

The combined Band IV and V field strength/distance curves for 1% and 10% of the time are re-drawn to a linear distance scale in Fig. 9, together with the Band IV and Band V 0·1% curves.

6.2. Comparison with C.C.I.R. Cannes 1961 Field Strength/Distance Curves

The field strength/distance curves for 1% and 10% Bands IV and V combined have been re-drawn in Fig. 10, together with the C.C.I.R. Cannes 1961 field strength/distance curves for this frequency range.

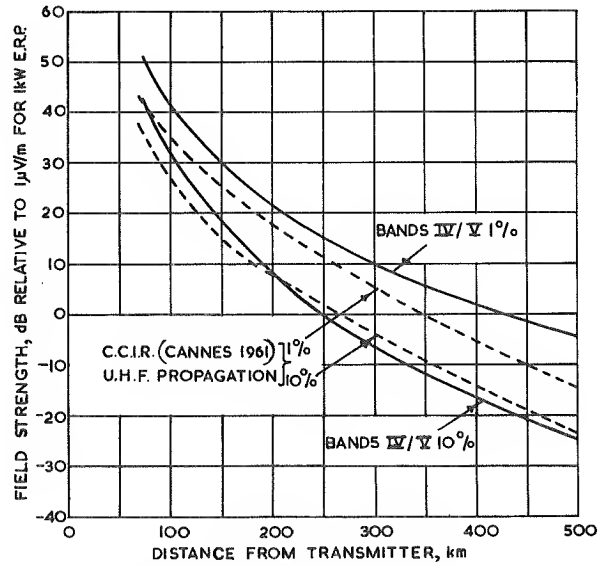

Fig. 10 - Comparison of C.C.I.R. (Cannes 1961) with Bands IV and V combined field strength/distance curves

The C.C.I.R. curves are for an effective transmitting aerial height of 300 m and a terrain of $\Delta h = 50$ m.

It will be seen that the difference between the 10% curves is small, not greater than 3 dB, beyond 150 km. These differences may well be due to differences in the laws selected to relate field strength with distance for the different curves. The 1% curve derived from the Band IV/V experiments gives field strengths in excess of the C.C.I.R. curve by amounts never less than 4 dB, the separation between the curves increasing at short and long distances.

Corrections should be made to the C.C.I.R. curves to allow for a higher Δh and a lower effective transmitting aerial height. These lead to a greater separation between the two 1% curves.

7. CONCLUSIONS

The investigations described in this report were conducted over land paths on Band V. The gradients of the field strength/distance curves derived from the measurements decrease with decreasing percentage times, implying a decreasing influence of distance on the received field strength under abnormal conditions. Comparisons made between measurements over the same and different paths indicate that for the greater proportion of the time there is no significant difference between tropospheric propagation in Bands IV and V. The 0·1% time field strengths are lower on Band V than Band IV.

Comparisons of Bands IV and V results with C.C.I.R. Cannes 1961 field strength/distance curves show good agreement for the 10% time curve although there are significant differences in the 1% curves.

8. ACKNOWLEDGEMENTS

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The Research Department staff concerned with the erection and maintenance of the apparatus and analysis of the data were Messrs. S.J. Ashdown and I. Rhodes and Mrs. P.A. Gagan.

9. REFERENCES

1. "Long Distance Overland Tropospheric Propagation Measurements at 495 and 560 Mc/s", Research Department Report No. K-149, Serial No. 1960/30.

2. "A V.H.F./U.H.F. Field Strength Recording Receiver", Research Department Report No. G-056, Serial No. 1955/13.

3. "A Correlation Detector: Its Application to a V.H.F./U.H.F. Field Strength Recording Receiver", Research Department Report No. G-056/2, Serial No. 1957/20.

4. "Long Distance Overland Propagation Measurements at 180·4 Mc/s", Research Department Report No. K-140, Serial No. 1959/23.

APPENDIX I

DISHFORTH CORRECTION FACTOR MEASUREMENTS

TRANSMISSIONS FROM PONTOP PIKE
BAND V (774 Mc/s)

Test No.	Temporary Site Grid Reference (100 km square SE)	Bearing from Transmitter TB	Site Height (a.m.s.l.)		Field Strength (dB)		Comparison of Field Strength of Temporary Site with Dishforth (dB)	Site Details and Topography Towards Transmitter
			ft	m	Temporary Site	Dishforth Site		
1	201707	178	840	256	54·0	48·5	+5·5	On top of hill. Open moorland.
2	235706	176	470	143	31·0	48·5	−17·5	Ground rises to 550 ft at ½ mile after drop to 450 ft at nearby stream bed.
3	267699	174	440	134	49·0	46·5	+2·5	Undulating country. Open site. Horizon distant.
4	294707	172	120	37	36·0	47·5	−11·5	Flat ground. Trees at ¼ mile.
5	345720	168	180	55	45·5	46·5	−1·0	Ground rising to 220 ft hill crest ¼ mile away.
6	392742	164	110	34	50·0	48·0	+2·0	Top of slope. Country flat and open.
7	412759	162	70	21	48·0	47·0	+1·0	Ground open and flat.
8	450759	160	100	30	47·0	47·5	−0·5	Flat ground. Low voltage wires at 100 yds.
9	473772	158	130	40	32·0	47·5	−15·5	Flat ground with rise to 200 ft at 1 mile. Trees at 200 yds and beyond.
10	506776	156	180	55	32·0	47·5	−15·5	Isolated trees at 30 yds, 10° off bearing. Ground rises gradually to 250 ft in ⅗ mile after slight fall to stream at 100 yds.
11	504800	155	420	128	20·5	48·5	−28·5	Looking towards hill. Ground rising to 500 ft in ⅔ mile.
12	515830	153	970	296	32·0	46·0	−14·0	Flat with low woods. In car park at top of Sutton Bank. 1000 ft hill at ⅔ mile.
13	569812	151	860	262	37·0	47·0	−10·0	Flat ground locally. Scrubland. Cleveland Hills in distance.
14	615818	148	350	107	9·5	47·5	−38·0	Ground falls to 200 ft at river bed ¼ mile away, then rises to Cleveland Hills.

Fixed site Dishforth Correction factor:- −10 dB

(Field strengths are expressed in dB relative to 1 μV/m for 1 kW e.r.p.)

APPENDIX II

MOORSIDE EDGE CORRECTION FACTOR MEASUREMENTS

TRANSMISSIONS FROM PONTOP PIKE
BAND V (774 Mc/s)

Test No.	Temporary Site Grid Reference	Bearing from Transmitter TB	Field Strength (dB rel. 1 μV/m for 1 kW E.R.P)			Comparison of Field Strength of Temporary Site with		Site Height (a.m.s.l.)		Site Details and Topography Towards Transmitter
			Temporary Site	Barnsdale Bar	Moorside Edge	Barnsdale Bar	Moorside Edge	ft	m	
1	SE/033156	186	15·5	–	20·5	–	-5·0	1260	384	Ground falls to 750 ft in 1 mile, then rises to further hills.
2	SE/137157	182	2·0*	–	16·5	–	-14·5	310	95	Ground falls to 230 ft and then rises to 500 ft ridge. Receiving aerial beamed across road junction in housing estate.
3	SE/240157	178	14·5	–	9·0	–	+5·5	630	192	Aerial beamed through gap in deciduous trees at 70 yds. Receiver on ridge.
4	SE/325166	174	9·5	36·5	–	-27·0	-11·0	150	46	Ground falls to plain about 70 ft below. 150 ft hill at about 2 miles.
5	SE/427184	170	33·0	59·0	–	-26·0	-10·0	130	40	Slight fall to 100 ft at ¼ mile, then rise to 160 ft at 1 mile, and colliery.
6	SE/512197	166	10·0	22·0	–	-12·0	+4·0	100	30	Flat open ground with dip at ¼ mile to less than 50 ft. Wooded ridge (100 ft) at ½ mile.
7	SE/607229	162	14·5	21·5	–	-7·0	+9·0	20	6	Flat ground. Medium voltage overhead power wires ¼ mile away.
8	SE/684254	158	10·5	21·5	–	-11·0	+5·0	10	3	Flat ground. Trees ½ mile away.
9	SE/774309	154	9·5	22·0	–	-12·5	+3·5	20	6	Flat ground. Trees ¾ mile away.
10	SE/873365	150	9·0	22·0	–	-13·0	+3·0	40	12	Flat ground.
11	SE/941413	146	8·0	26·5	–	-18·5	-2·5	350	107	Hills 2 miles away rising to 350 ft with lower ground between.
12	TA/018468	142	12·0	30·0	–	-18·0	-2·0	30	9	Flat. Ground rises to 50 ft at 1 mile.
	SE/515139 (Barnsdale Bar)			23·0	7·0		(-16 dB)	230	70	Ground falls to 100 ft then rises to 200 ft tree-covered crest at 2 miles.

Fixed Site Moorside Edge Correction factor:- -1 dB

(Field strengths are expressed in dB relative to 1 μV/m for 1 kW e.r.p.)

*Extrapolated value.

BRH

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